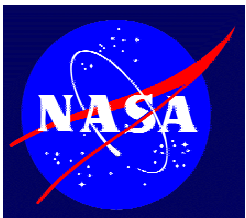


Understanding Synoptic Controls on North American Pollutant Export using TES Observations

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Scientific Questions

- What are the primary atmospheric circulation mechanisms in each season that determine the North American export of air pollutants?
- What are the spatial and temporal variations in tropospheric ozone (O_3) and its precursors over the North Atlantic that correspond to the various circulation scenarios?
- How does seasonal and interannual variability in circulation dynamics affect background O_3 levels over the North Atlantic?

Focus: Lower tropospheric O_3 and CO for eastern North America and adjacent North Atlantic for major circulation types during each season using retrievals from the Tropospheric Emission Spectrometer (TES).

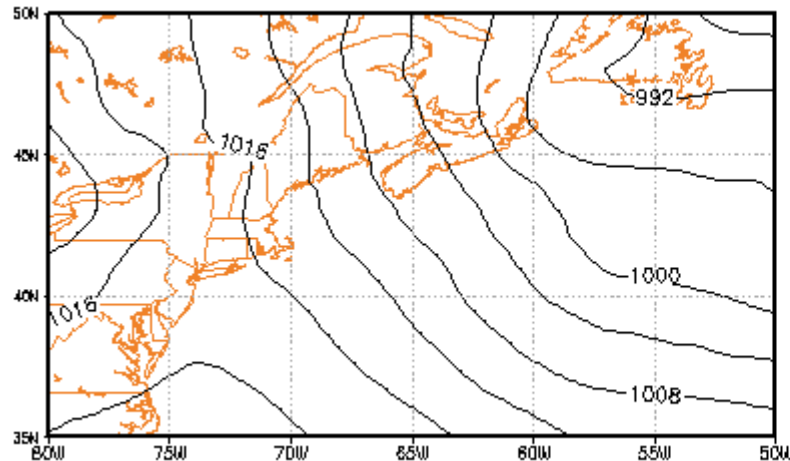
Approach

- Use correlation-based synoptic classification scheme [Lund, 1963] to identify predominant circulation patterns or map types.
 - Details see Hegarty et al., [2007]
- Data Source:
 - NCEP Global Final Analysis at $1^\circ \times 1^\circ$ horizontal resolution
 - 12 UTC sea level pressure (SLP) fields
- Time Period: 2000 - 2006

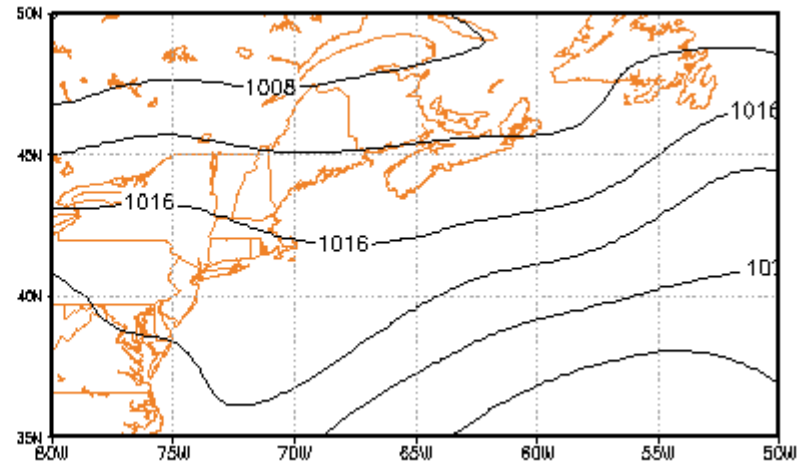
Synoptic classification results: Identified 4 -7 predominant map types for each season. Approximately 70% of patterns classifiable as one of the predominant types

For each map type created composite O_3 and CO analyses from 2005 – 2006 TES V002 L2 data.

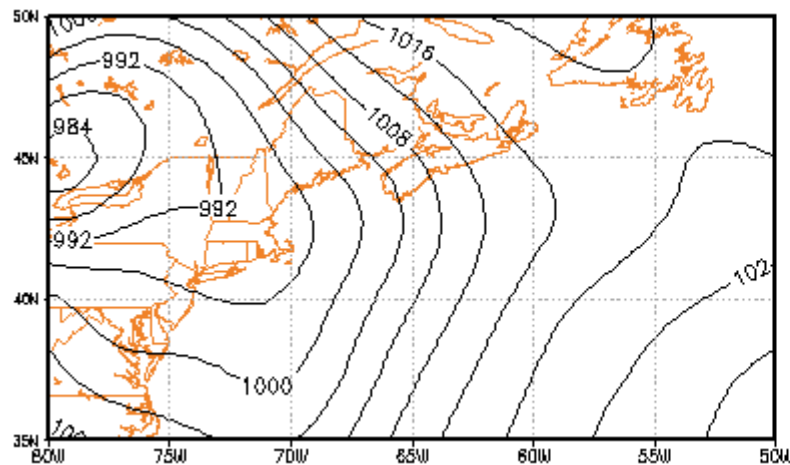
DJF Map Types



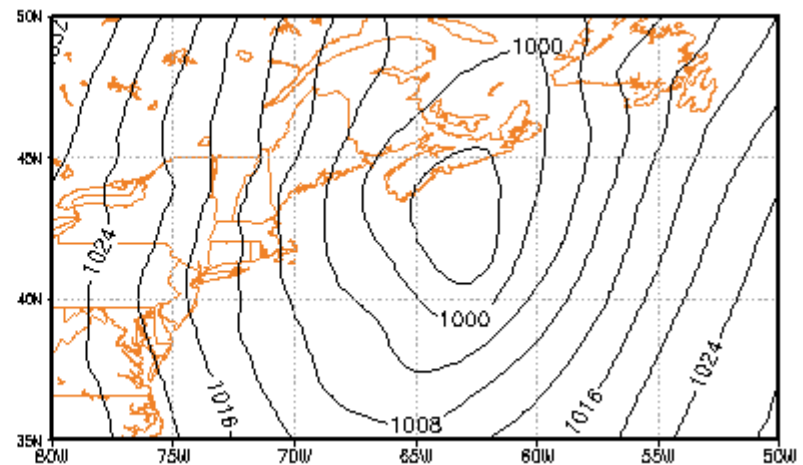
MT 1



MT 2



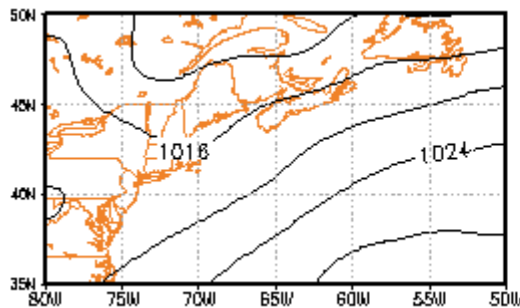
MT 3



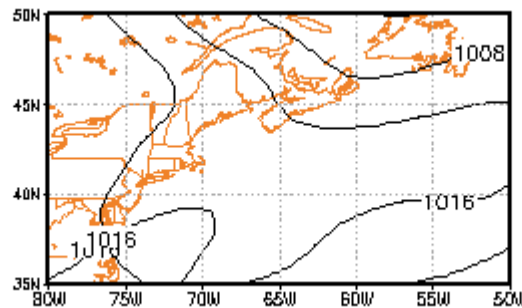
MT 4

SLP (contoured every 4 hPa)

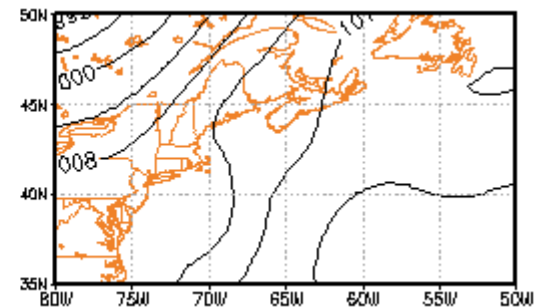
JJA Map Types



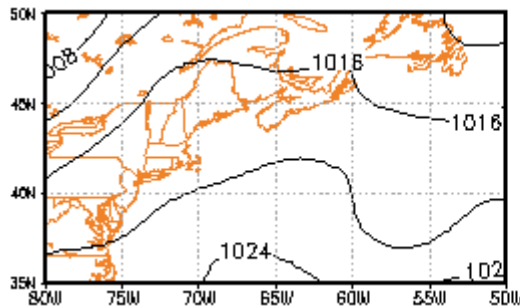
MT 1



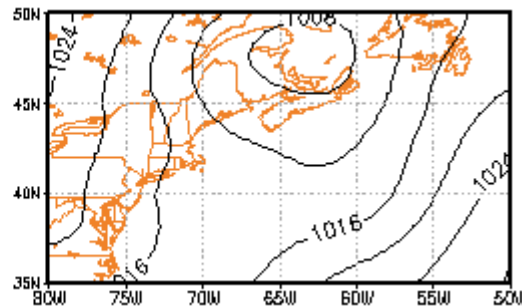
MT 2



MT 3



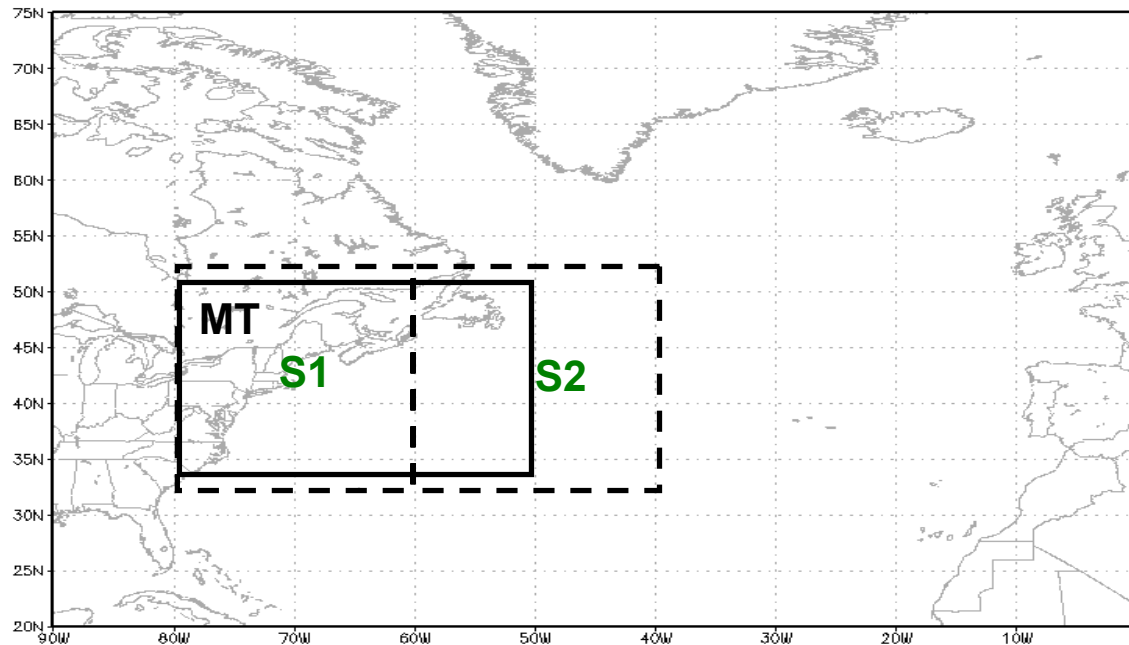
MT 4



MT 5

SLP (contoured every 4 hPa)

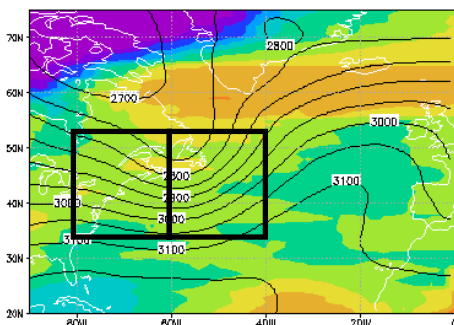
Export Domains



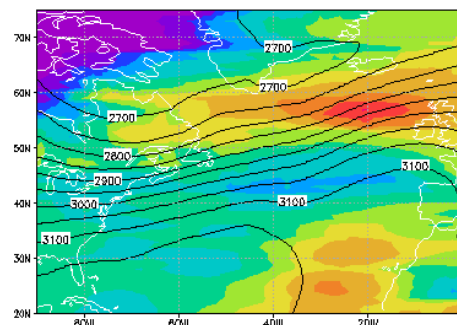
MT : Map typing domain

S1 and S2: Sub-domains for calculating regional
O₃ and CO correlations

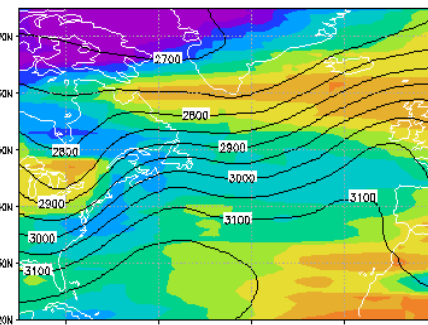
DJF O₃ and CO at 681 hPa



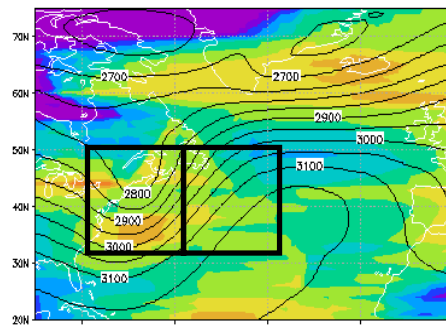
MT 1



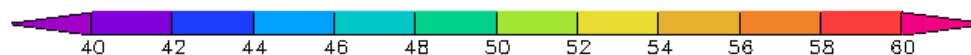
MT 2



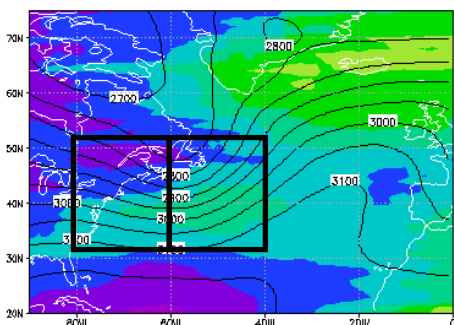
MT 3



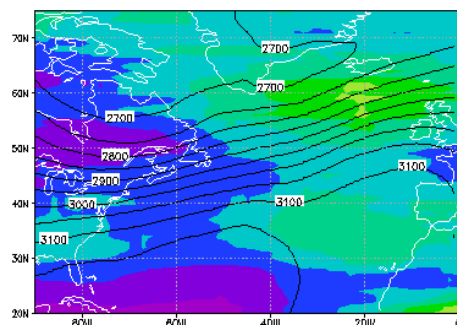
MT 4



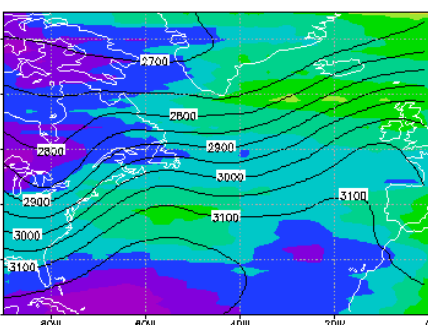
O₃ (ppbv)



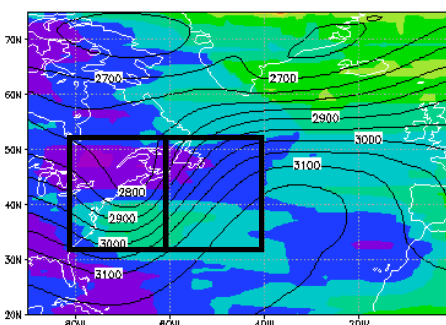
MT 1



MT 2



MT 3



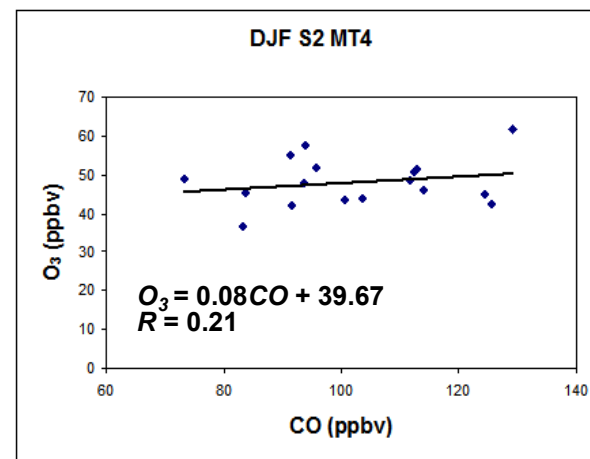
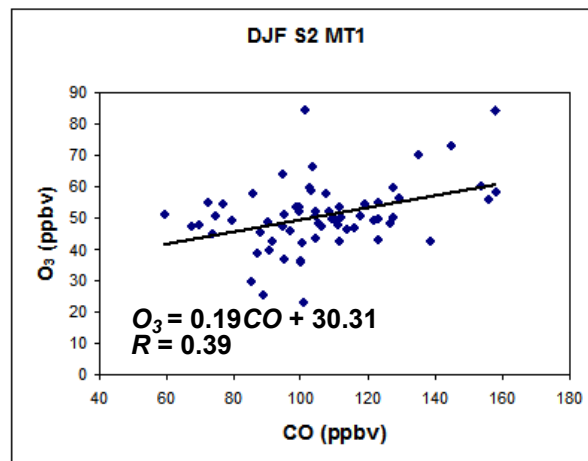
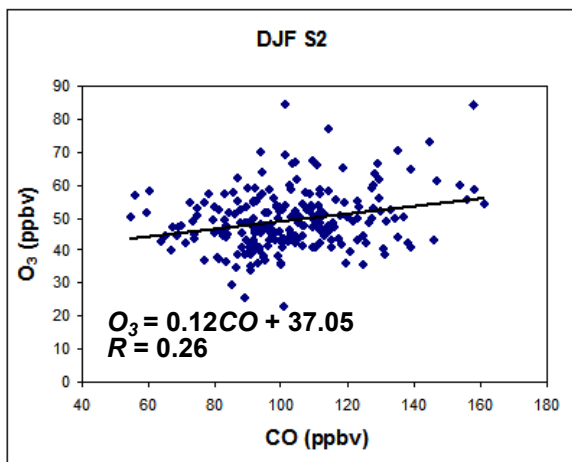
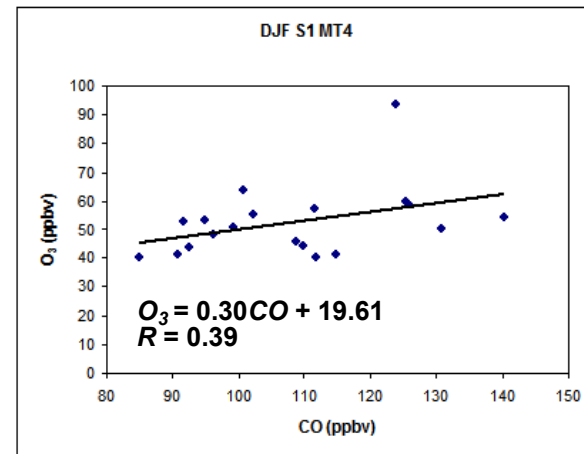
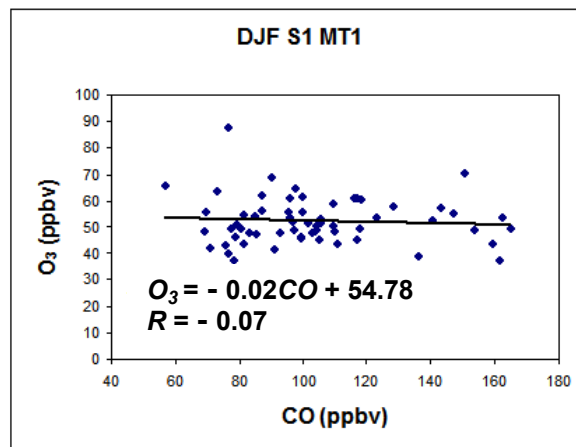
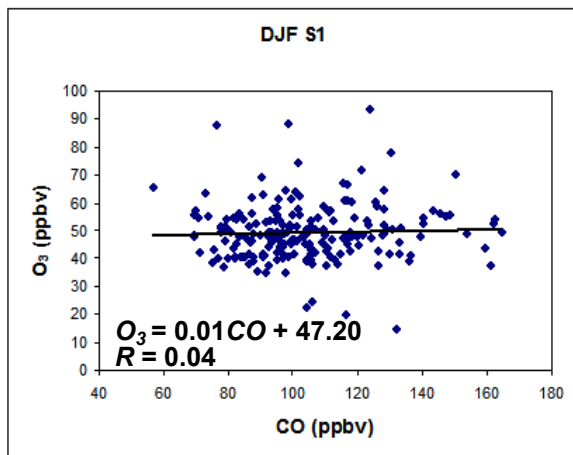
MT 4



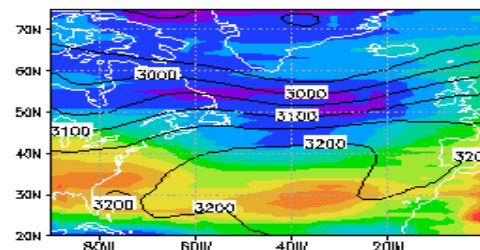
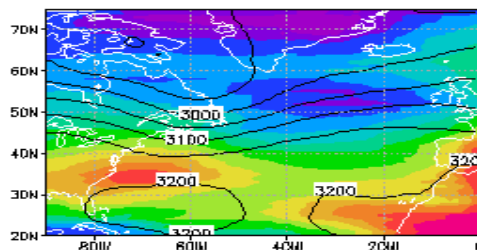
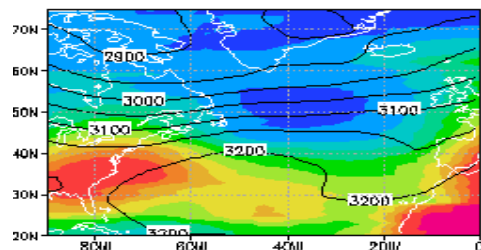
CO (ppbv)

700 hPa contoured in black

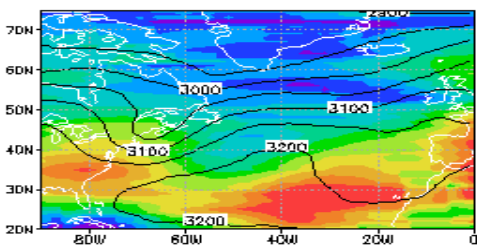
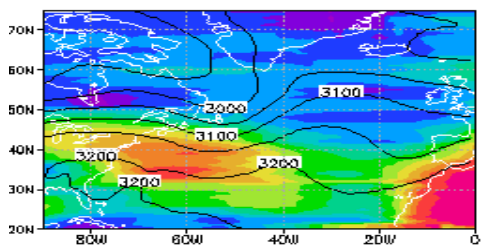
O₃-CO DJF



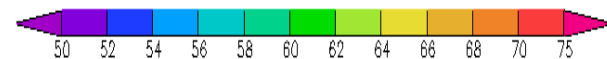
JJA O₃ and CO at 681 hPa



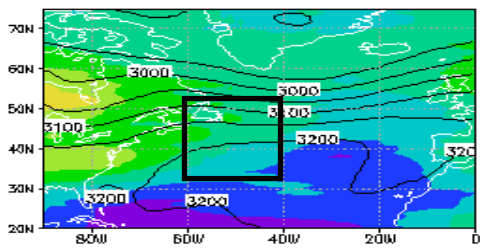
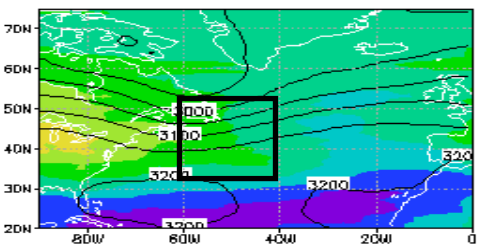
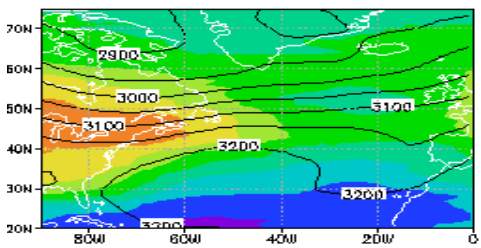
MT 1 - 3



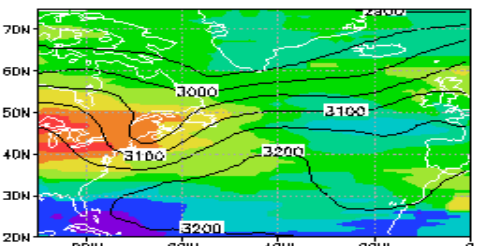
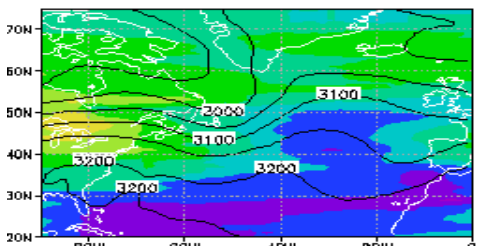
MT 4 - 5



O₃ (ppbv)



MT 1 - 3

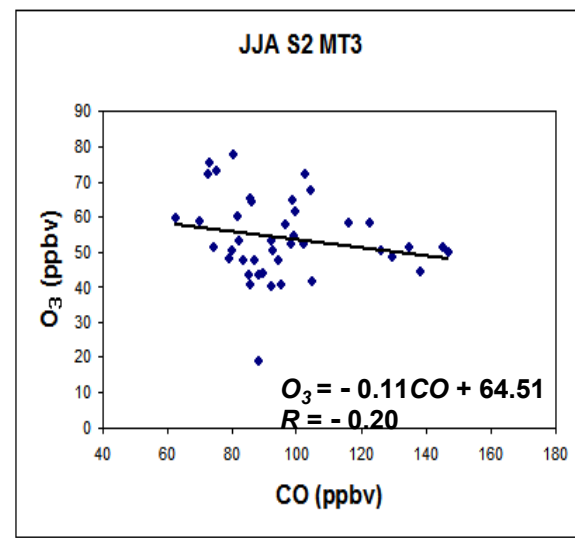
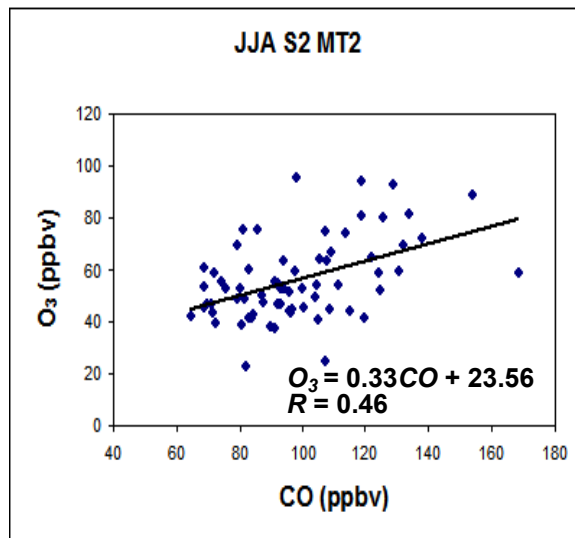
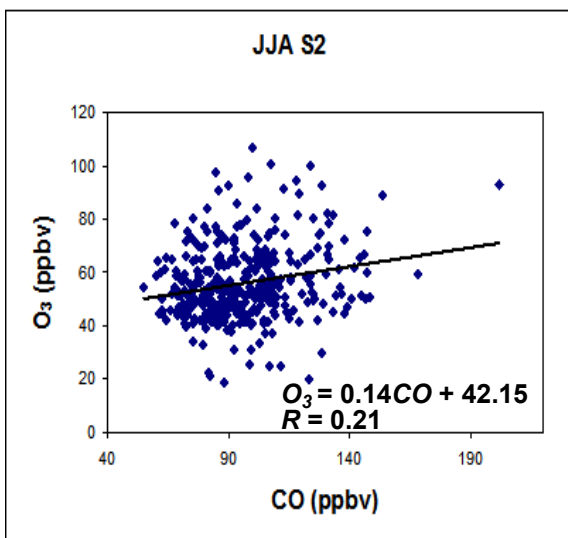


MT 4 - 5

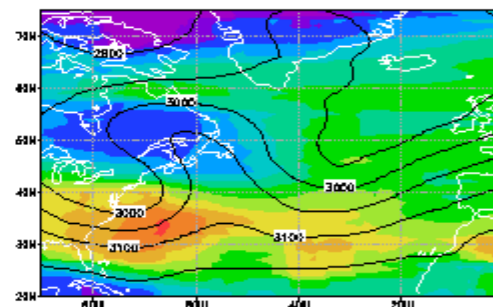
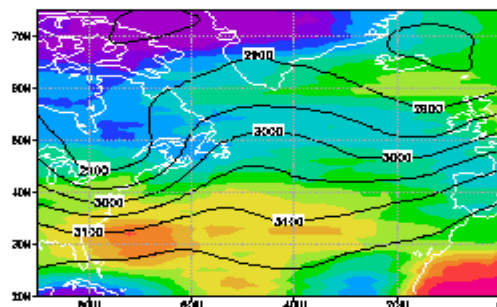
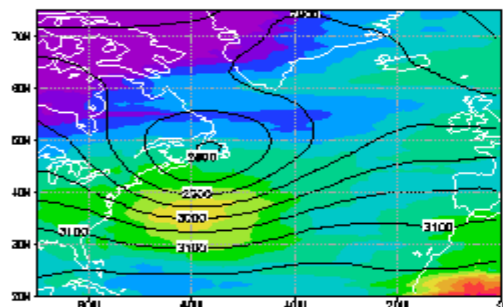


CO (ppbv)

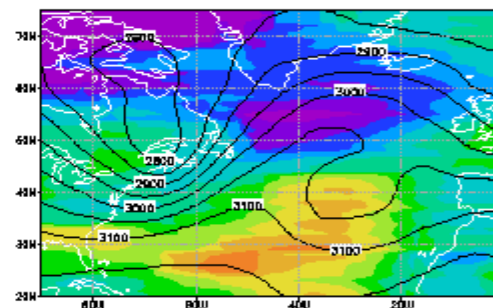
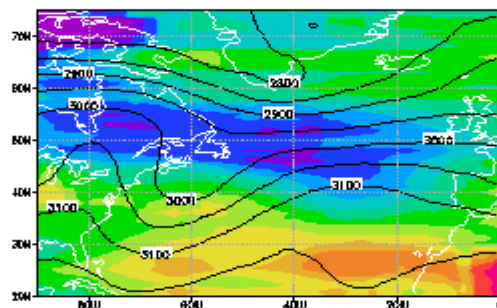
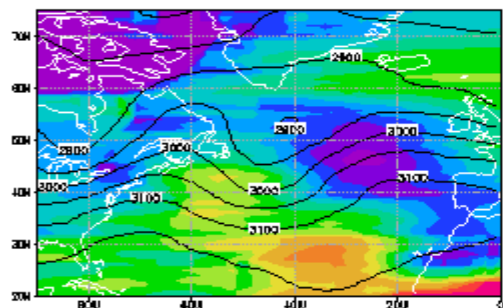
JJA O₃-CO



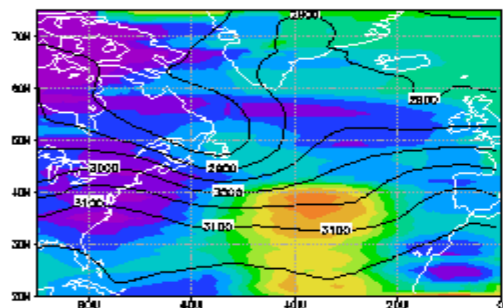
MAM O₃ at 681 hPa



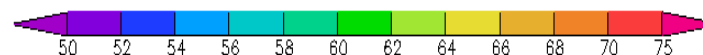
MT
1 - 3



MT
4 - 6

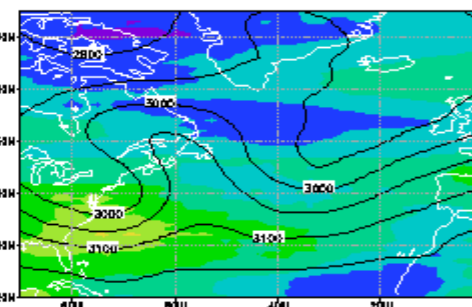
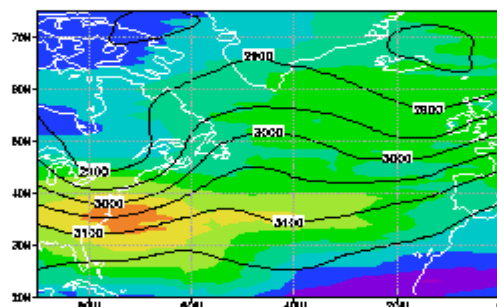
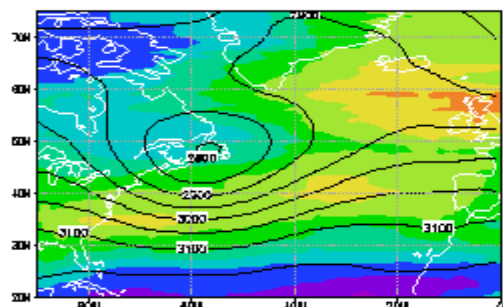


MT 7

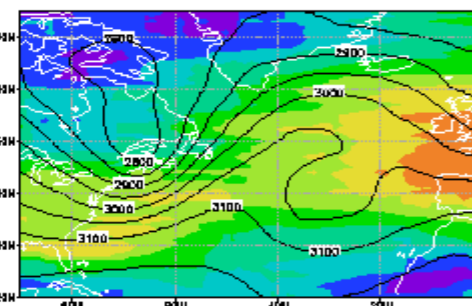
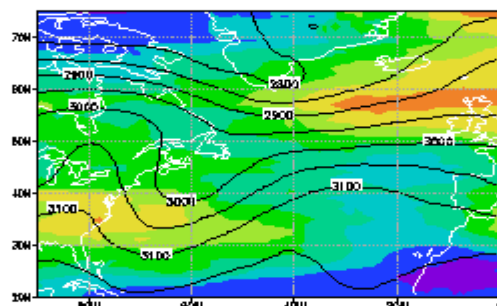
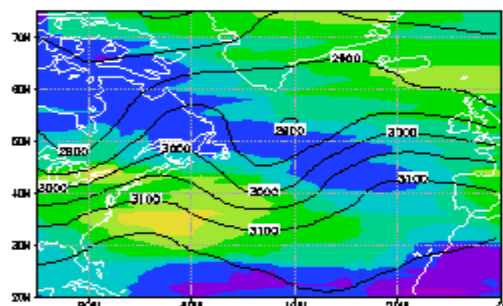


O₃ (ppbv)

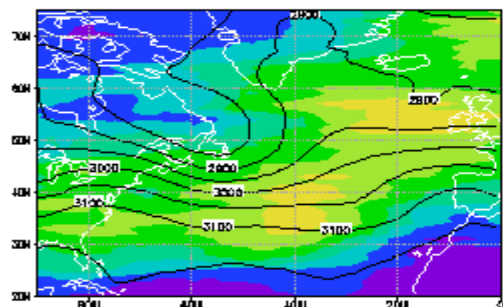
MAM CO at 681 hPa



**MT
1 - 3**



**MT
4 - 6**

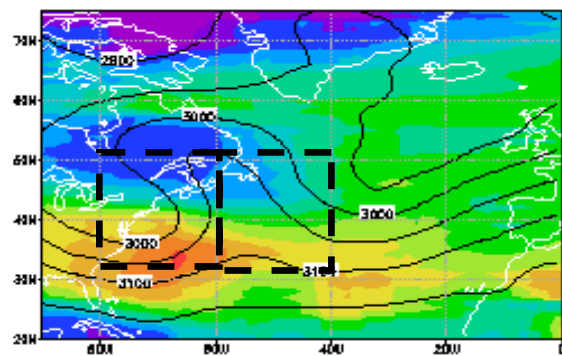


MT 7

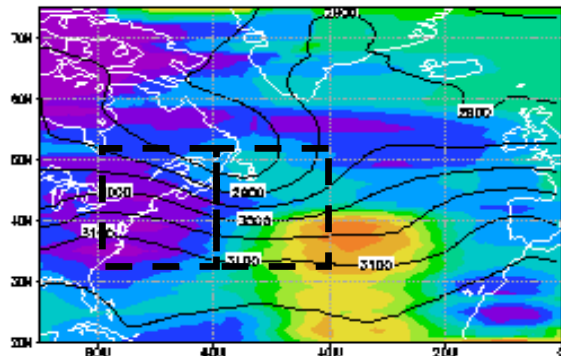


CO (ppbv)

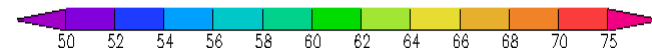
MAM O₃ and CO at 681 hPa MT 3 and MT 7



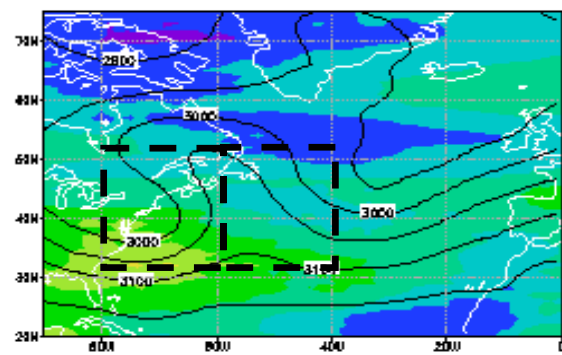
MT 3



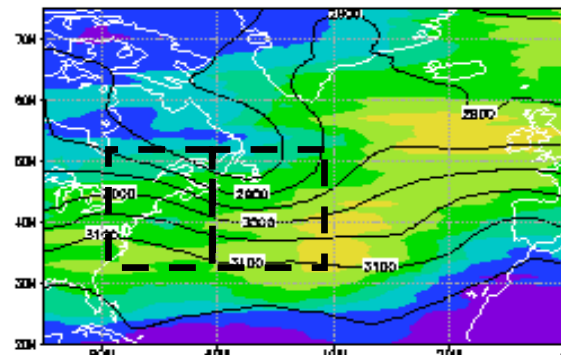
MT 7



O₃ (ppbv)



MT 3



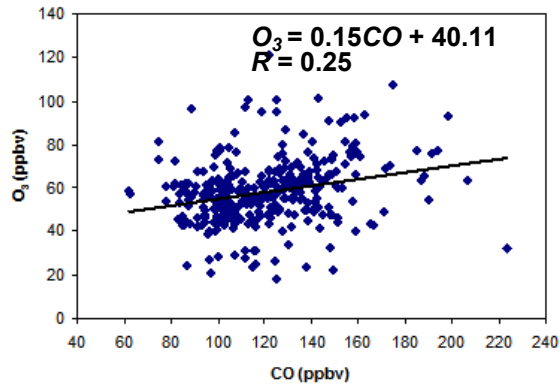
MT 7



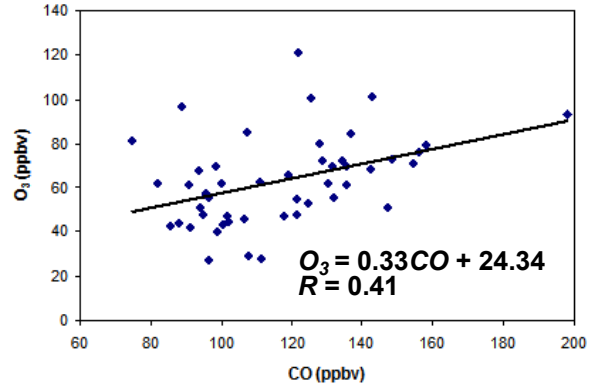
CO (ppbv)

MAM O₃-CO

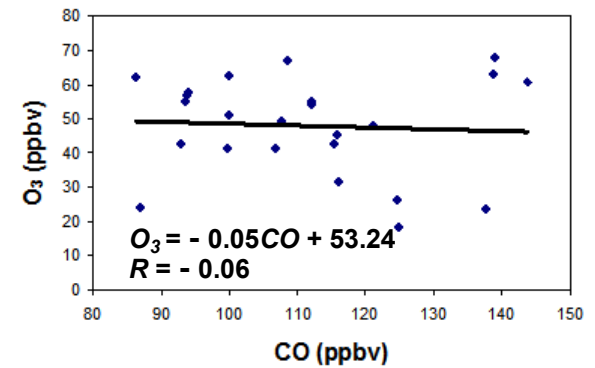
MAM S1



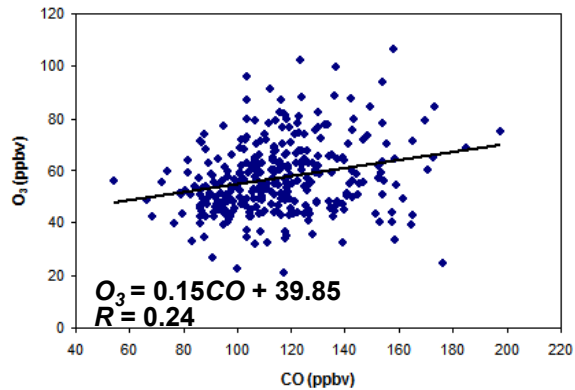
MAM S1 MT3



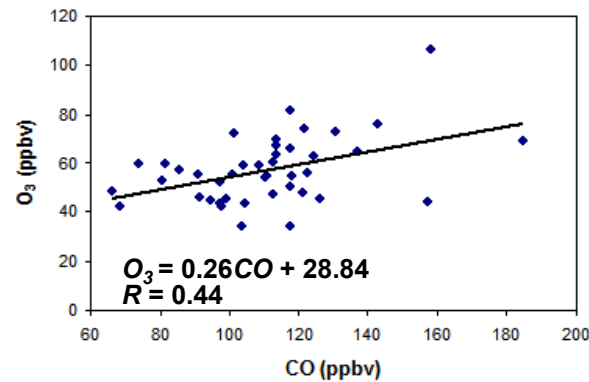
MAM S1 MT7



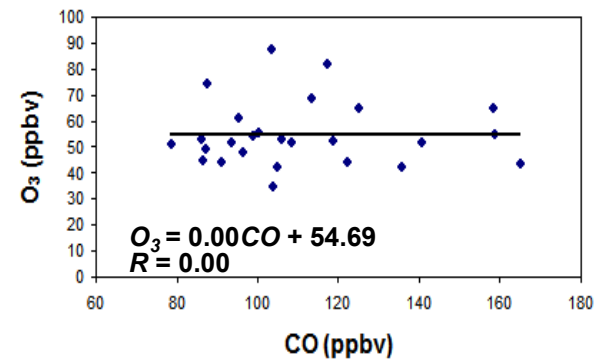
MAM S2



MAM S2 MT3



MAM S2 MT7



- Summary

- TES lower tropospheric O₃ and CO distributions over eastern North America and North Atlantic influenced by circulation dynamics.
- O₃ - CO correlated positively downwind of troughs (weather systems) crossing east coast of U.S. indicates anthropogenic influence.

- Ongoing and Future Work

- Examination of TES upper tropospheric O₃ and CO distributions
- Case study analysis utilizing TES special observation periods and IONS-06 network (July - August 2006)
 - Interpreting measurements using regional modeling tools (*e.g.* MM5-CMAQ)
- ICT potential of various circulation scenarios
 - GEOS-CHEM model